

REMARKS

Claims 1 and 4-21 are all the claims pending in the application.

Applicants have amended claim 17 to make it more consistent with claim 1. Applicants request that the Examiner enter this amendment because the amendment should not require any additional searching and it places the application in better condition for appeal.

PRIOR ART REJECTIONS

The Examiner has rejected claims 1 and 4-21 under 35 U.S.C. § 103(a) as being unpatentable over Akram (U.S. Patent No. 6,424,033) in view of Hoffman (U.S. Patent No. 6,737,750). Applicant traverses these rejections because one of skill in the art would not have modified Akram based on Hoffman to arrive at the claimed invention.

The Examiner has acknowledged that Akram fails to disclose “a third plurality of wires connecting said secondary IC structure to said base IC structure” as defined in present claim 1. However, the Examiner argues that the third plurality of wires would have been an obvious modification of the “ball array” disclosed in Akram. Applicant respectfully disagrees for the reasons contained below, which are supported by the accompanying Declaration Under 37 C.F.R. § 1.132 of Anthony Sun Yi Sheng, one of the inventors.

When you compare the structure of Figure 2 of Akram et al. with an exemplary package of the claimed invention as depicted in Figure 5, there are clear differences between the two structures which are not result of a mere workshop modification.

Referring to Figure 2 of Akram, a second BOC chip package (i.e., chip 112 and substrate 114) is mounted onto a base BOC chip package (i.e., chip 12 and substrate 14). The second BOC chip package is electrically connected to the base BOC chip package by solder balls 132.

The solder balls 132 additionally provides a stand-off height between the two BOC chip packages so that wire bonds of the second BOC chip package do not get too close to the lower chip 12 and become damaged.

Without the solder balls 132, the second BOC chip package in Akram cannot be supported above the base BOC chip package. Even with wire bonds replacing the solder balls, there will still be no support because the thin wire bonds are not mechanically strong enough to hold the second IC structure above the base IC structure.

Therefore, if one were to replace the solder balls 132 in Akram with wire bonds, it will not be just a mere replacement job that results in the present claimed invention. Rather a complete redesign of the entire package structure is required.

One modification would be to include spacers between the two IC structures. However, including spacers would not lead to the present claimed invention, thereby emphasizing that the present claimed invention is not a mere workshop alteration of Akram.

The present invention, as defined in claim 1, provides a secondary IC structure over a base IC structure. The base IC structure comprises a base substrate, a first semiconductor chip and a first plurality of wires. The secondary IC structure comprises a second substrate, a second semiconductor chip, a second plurality of wires and a first encapsulant. The first encapsulant (i.e., encapsulant 421 of Figure 5 of the present application) fills the secondary opening around the second plurality of wires and covering the second secondary substrate face.

To enable stacking of the secondary IC structure over the base IC structure, the secondary IC structure is provided with the first encapsulant which, not only protects the second plurality of wires from the environment, but also supports the secondary IC structure sufficiently to prevent the second plurality of wires from contacting the first semiconductor chip. Wire bonding can be

performed to provide the third plurality of wires to electrically connect the second substrate to the base substrate. A separate encapsulant (i.e., encapsulant 525 of Figure 5 of the present application) may then be provided to cover over the entire secondary IC structure and portions of the base IC structure, if desired, for example to protect the third plurality of wires. Therefore, unlike the solder ball electrical connections 132 of Akram, the third plurality of wires do not provide any form of mechanical support to the secondary IC structure.

Akram does not teach nor suggest the use of an encapsulant material to prevent contact between the second plurality of wires with the first semiconductor chip. Referring to Figure 2 of Akram, there is no separate first encapsulant that covers the opening around the wire bonds and the bottom surface of the second substrate. Instead, the encapsulant (grease 22) forms one common mass which covers the second IC structure including the wire bonds.

Thus, the present claimed invention is not just a mere replacement of the solder ball connections 132 in Akram with wire bonds, and involves creative designing of the entire package structure to enable proper stacking and electrical connection of two or more IC structures based on the combination of features as defined in present claim 1.

Even if the wire bonds are capable of providing the requisite support, there would be no motivation to look to Hoffman to modify Akram to arrive at the present claimed invention. Hoffman uses a support structure 14 to prevent contact between the top die and the bottom die. The support structure can be a conductive path that provides a ground or other reference voltage to a bond pad [see col. 5 lines 60-64]. Hence, if one were to combine the teachings of Akram with Hoffman, one would have been motivated to design a package to include such a support structure with wire bonds to replace the solder balls, and would not arrive at the package

structure as defined in present claim 1 which uses the first encapsulant as a form of support and wire bonds for electrically connecting the secondary IC structure to the base IC structure.

Referring to the Examiner's comments to arguments a) and b) in paragraph 17 of the office action, even if one were to replace just one solder ball on each side of the substrate opening with wires such that the other solder balls support the substrate, or replace all of the solder balls with wire bonds, there are still challenges in supporting the secondary IC structure above the base IC structure. Solder balls are typically heated or reflowed to form a secured electrical connection between two components. During reflow, the solder balls will tend to collapse and care must be exercised to control the collapse so that the upper IC structure does not tilt or be brought too close to the bottom chip. In the present claimed invention, there is no such worry as the first encapsulant is formed on the secondary IC structure before mounting onto the base IC structure. Hence, there is a distinct advantage of the present claimed invention over Akram.

Referring to the Examiner's comment to argument c) in paragraph 17 of the office action, the Examiner states that "the third plurality of wires can be considered wire 16b, which connects the secondary substrate 14 to the base substrate 10 via chip 16a and wire 20." The Examiner appears to have misunderstood Hoffman. First, element 16b is the inactive surface of the second die 16 [see col. 5 line 65 to col. 6 line 3] and not a wire. Also, wire 20 connects the chip 16a directly to the base substrate 10 and does not connect the secondary substrate 14 to the base substrate 14.

Even if element 14 can be interpreted such that portion 14c is the second substrate, portion 14a is the electrical connection between the second substrate and the base substrate, it is clearly a different feature from the combination of the first encapsulant (which supports the

second substrate) and third plurality of wires (which electrically connects the two substrates) as defined in present claim 1.

In light of the above arguments, it is respectfully requested that the Examiner reconsider the rejection and allow claim 1.

The same arguments for claim 1 would also apply for Independent claims 10 and 17.

Also, the remaining dependent claims are also allowable by virtue of their dependencies on claims 1, 10 and 17

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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